Alcatel-Lucent 7705 SAR

SERVICE AGGREGATION ROUTER | RELEASE 1.0

The Alcatel-Lucent 7705 Service Aggregation Router (SAR) delivers industry-leading IP/MPLS and pseudowire capabilities in a compact platform that has the ability to groom and aggregate multiple media, service and transport protocols onto a normalized, economical packet transport infrastructure.

The Alcatel-Lucent 7705 SAR is extremely well suited to the transport needs of the evolving mobile radio access network (RAN). The platform delivers strong convergence capabilities in the mobile RAN with native service processing of 2G, 3G and 4G traffic. In addition, the platform can provide a powerful solution for wireline aggregation and routing in carrier and enterprise applications. For example, the Alcatel-Lucent 7705 SAR can be deployed in a T1/E1 private line multiplexing environment.

The Alcatel-Lucent 7705 SAR owes much of its development heritage to the Alcatel-Lucent Service Router (SR) product line. Sharing much of the market-leading feature set of that product, the Alcatel-Lucent 7705 SAR brings a powerful, service-oriented capability to the RAN, but in a form factor and at a price point that are particularly appropriate for cell sites and hub locations. With end-to-end service management under the Alcatel-Lucent 5620 management portfolio, the Alcatel-Lucent 7705 SAR greatly augments the IP/MPLS RAN transport solution from Alcatel-Lucent.

Industry-leading scalability and density is provided in the 8-slot, two rack unit (RU) version that supports up to 96 T1/E1 Any Service, Any Port (ASAP) ports. On the network uplink side, media connectivity options are: Ethernet, Fast Ethernet (FE), Gigabit Ethernet (GE), or n xT1/E1 Multi-Link Point-to-Point Protocol (MLPPP). The platform can be optionally configured with a redundant core control module and uplinks. The Alcatel-Lucent 7705 SAR-8 has eight slots; two are allocated for control and switch modules (CSMs), with the remaining six being available for user traffic adapter cards. The Alcatel-Lucent 7705 SAR has a compact modular architecture, constructed to allow flexible use of line adapter cards so operators can optimize the configuration to meet the specific requirements of a site.

With the modular architecture comes additional resilience and flexibility. The solution can optionally support 1+1 fully redundant CSMs. Each adapter card has dual paths to the active and standby CSMs. Each of the six adapter card slots can be used for any adapter card type, removing the burden of complex pre-engineering and future scenario planning. The two adapter card types supported in Release 1.0 are a 16-port ASAP T1/E1 adapter card and an 8-port Ethernet adapter card.

The ASAP adapter card supports ATM, inverse multiplexing over ATM (IMA), TDM and MLPPP. The Ethernet adapter card has six ports of auto-sensing 10/100 Base-T ports plus two further ports supporting 10/100/1000 Base TX with small form factor pluggable (SFPs) optics. Each slot is connected to the switching fabric on the CSM via a 1 Gb/s link to host existing and future interface types.

Service aggregation and networking

To provide the most efficient transport solution, the Alcatel-Lucent 7705 SAR employs pseudowire encapsulation (PWE3) methods to map services end to end. The use of pseudowires ensures that the key attributes of the service are maintained, while using a cost-effective packet environment to aggregate services.

The Alcatel-Lucent 7705 SAR supports RFC 5086 — Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN) for the encapsulation and transport of TDM traffic, for example, 2G TDM services. The use of circuit emulation service (CES) ensures that only the active timeslots are transported, keeping bandwidth usage to a minimum. The Alcatel-Lucent 7705 SAR also supports RFC 4717 — Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks (also known as draft-ietf-pwe3-atm-encap). The Alcatel-Lucent 7705 SAR supports N:1 cell mode for transport of ATM-based services. Multiple access ATM ports are bundled together to attain higher speeds using IMA. The IMA protocol is terminated on the Alcatel-Lucent 7705 SAR and only the cells containing user data belonging to a virtual circuit/virtual path (VC/VP) structure are transported.

In addition, the Alcatel-Lucent 7705 SAR supports RFC 4448 — Encapsulation Methods for Transport of Ethernet over MPLS Networks, which specifies how Ethernet pseudowires can be used to transport Ethernet traffic across the packet network. To offer greater scalability, all the traffic out of an Ethernet port can be carried over a single Ethernet pseudowire or, alternatively, a pseudowire can be created for each VLAN that is assigned to a different service or end-customer. When dynamic signaling is deployed, the end-to-end pseudowire is established using targeted label distribution protocol (T-LDP) and the MPLS tunnel via LDP. In addition to efficient LDP-based dynamic signaling, static provisioning of both the MPLS tunnel and the pseudowire is also supported.

Quality of service and traffic management

It is critical to maintain the end-to-end quality of service (QoS) for packet traffic. Not all types of traffic have the same set of requirements. Voice traffic in particular requires low latency and jitter (latency variation) and also low loss, whereas data traffic often has less stringent delay requirements but may be very sensitive to loss, as packet loss can seriously constrain application throughput. To offer the required treatment throughout the network, traffic flows with different requirements are identified at the access and marked in-line with the appropriate QoS metrics. Traffic classification and marking is carried out based on the following:

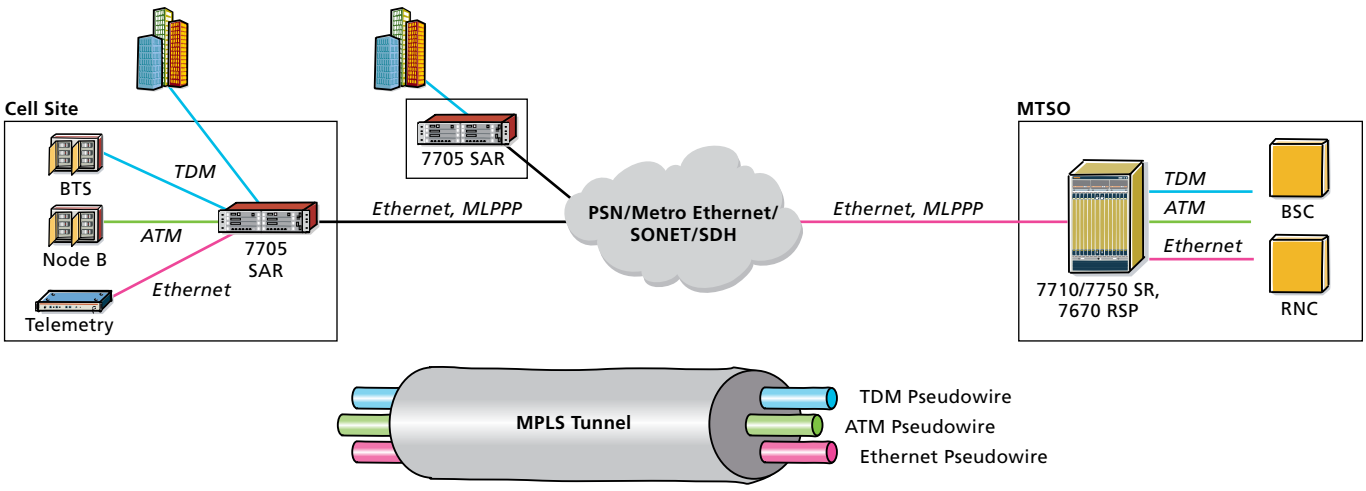
Classification (Layer 1/Layer 2/Layer 2.5 and/or Layer 3 header):

- Timeslot/port
- Ethernet port/VLAN
- ATM service category (CBR/rt-VBR/nrt-VBR/UBR)
- ATM VC
- Ethernet 802.1p/VLAN
- IP DSCP/MPLS EXP

Marking:

- Layer 2 (802.1p)
- Layer 2.5 (EXP) both for tunnel and PWE3
- Layer 3 (DiffServ)

Figure 1. Low-cost, high-quality backhaul using MPLS pseudowires



MPLS Pseudowires Allow Convergence and Dynamic Bandwidth Allocation Over Multiple Media, Enabling Low Cost Backhaul

The Alcatel-Lucent 7705 SAR utilizes extensive traffic management policies to ensure fairness with detailed classification and hierarchical scheduling including minimum/maximum, profiled, round robin and strict priority scheduling and multi-tier policing to differentiate and prioritize individual services and flows.

Operations, administration and maintenance

In order to ensure continuity of services, the Alcatel-Lucent 7705 SAR has a full set of operations, administration and maintenance (OAM) features including:

- LSP ping
- LSP traceroute
- Service distribution path (SDP) ping
  - ¬ Verifies, for example, tunnel connectivity and round trip delay
- Virtual circuit connectivity verification (VCCV)
  - ¬ Verifies, for example, service level existence and round trip time
  - ¬ Extends OAM to pseudowire services
- Service Assurance Agent (SAA)
  - ¬ Runs in background, periodically collecting network "health" information from OAM mechanisms such as VCCV and monitoring for problems such as SLA transgressions.

These features, when under the control of the Alcatel-Lucent 5620 management portfolio, ensure rapid fault detection as well as efficient troubleshooting. In particular, SLAs can be monitored, and transgressions detected and reported via the SAA.

Synchronization

Cell sites rely on the backhaul network to provide synchronous interfaces for the proper delivery of data. In addition, cell sites may rely on the network interfaces as stable references with which to derive radio frequencies (RFs) and in order to ensure reliable subscriber handover between cell towers.

The Alcatel-Lucent 7705 SAR supports external reference timing, line timing and adaptive timing in Release 1.0. The adaptive timing is fully capable of offering end-to-end synchronization. In addition, the Alcatel-Lucent 7705 SAR is completely hardware-ready to support IEEE1588v2. This IEEE standard defines a method to minimize the effects of delay and delay variation (jitter). This is accomplished by a combination of built-in architectural features and also powerful QoS mechanisms to minimize the delay experienced by synchronization traffic. This is a cornerstone of the design of the Alcatel-Lucent 7705 SAR. A built-in Stratum-3 clock is available in the control and switch module to assist in synchronization maintenance.

Features

- Cost-effective migration from E1/T1-based backhaul to packet-based transport, leveraging Ethernet services over a wide range of first mile media.
- Resiliency and redundancy including: one-for-one hitless control and switch module failover, synchronization redundancy, network uplink resiliency and redundancy of power feeds.
- Powerful, service-aware OAM capabilities complemented by the Alcatel-Lucent 5620 management portfolio for GUI-based network and element configuration, provisioning, fault and performance management.
- Dense adaptation of multiple converged services onto an economical packet infrastructure.
- Extends service routing IP/MPLS capabilities to the cell site, hubs and network edge in a compact form factor.
- Dynamic tunnel signaling for scaling, ease of establishment and resiliency.

Benefits

- Transition from PDH-based connectivity to Ethernet-based can greatly reduce recurring operating expenditures such as line lease costs.
- Advanced resiliency features lead to improved network uptime, which can positively impact customer retention and allow critical services to be offered for increased revenue.
- Rapid fault detection and powerful commissioning and troubleshooting tools can improve productivity of operations staff and reduce network downtime.
- Multiprotocol and convergence capabilities (with flexible and granular QoS) reduce equipment instances needed to carry multiple fixed and mobile traffic streams.
- Modular, flexible architecture alleviates the burden of complex pre-engineering and future scenario planning.

Technical specifications

Modules and adapter cards

- Control and switch module (CSM)
- 8-port Ethernet adapter card (six ports of 10/100 Ethernet, two ports of 10/100/1000 Ethernet)
- 16-port T1/E1 Any Service, Any Port (ASAP) adapter card

Services

- TDM pseudowires
  - ¬ RFC 5086 Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)
- ATM pseudowires
  - ¬ RFC 4717 Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks
  - ¬ N:1 cell mode, virtual circuit connection and virtual path connection
  - ¬ ATM IMA
- Ethernet pseudowires
  - ¬ RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks
  - ¬ Raw and tagged mode

Synchronization

- External reference timing
- Line timing
- Adaptive timing
- Built-in Stratum-3 clock
- Hardware-ready to support IEEE 1588v2

Redundancy and resiliency

- Control
- Fabric
- Synchronization
- Uplinks
- MPLS tunnel
- Power feeds

Traffic management and QoS

- Hierarchical queuing
- Multi-tier scheduling
- Profiled (in and out of profile) scheduling
- Queue type-based scheduling
- Ingress policing and egress shaping
- Up to 8 queues per service
- Memory allocation per queue (CBS, MBS per queue)
- Premium, assured and best-effort forwarding classes
- WRED on ingress and egress
- Classification based on:
  - ¬ Layer 1/Layer 2/Layer 2.5 and/or Layer 3 header
  - ¬ Timeslot/port
  - ¬ Ethernet port/VLAN
  - ¬ ATM service category: (CBR/rt-VBRrt-VBR/UBR)
  - ¬ ATM VC
  - ¬ Ethernet 802.1p/VLAN
  - ¬ IP DSCP/MPLS EXP
- Marking based on:
  - ¬ Layer 2 (802.1p)
  - ¬ Layer 2.5 (EXP) both for tunnel and PWE3
  - ¬ Layer 3 (DiffServ)

Security (node access)

- User ID/password-based authentication and authorization
  - ¬ Exponential login backoff for brute force attacks
  - ¬ Local or remote storing of user-info
- Remote authentication/ authorization via Remote Authentication Dial In User Service (RADIUS) and Terminal Access Controller Access-Control System (TACACS)
- Secure Shellv2, Secure File Transfer Protocol and Simple Network Management Protocol (SNMP) Version 3
  - ¬ Secure open interfaces
- Syslog
  - ¬ Capture security logs on local or remote server
- Alarm on suspicious sequence of operations
- Nodal attack
- Basic firewall with filtering of control plane traffic
- Denial of service (DoS) attack prevention (rate-limiting and prioritization)
- Data security
- Transfer over peer-to-peer tunnel (MPLS)
- MD5 authentication
- Sequence numbers prevent replaying of data
- Statistics available on suspicious behavior

Management

- Fully-featured, industry-standard command line interface
- Port and service mirroring
- Service assurance tools, including LSP ping, LSP traceroute, SDP ping, VCCV
- SSH and Telnet
- FTP, Trivial File Transfer Protocol and Secure Copy Protocol
- RADIUS (AAA)
- TACACS+
- SNMP v2/v3

Safety standards and regulatory compliance

- Safety: CSA 60950-1 2001
- EMC:
  - ¬ EN55022 1998 (Class A)
  - ¬ FCC Part 15 - 2003 (Class A)

Physical dimensions

- Height: 2 RU, 8.9 cm (3.5 in.)
- Depth: 25.4 cm (10 in.)
- Width: 48.3 cm (19 in.)
- Rack mountable in a 30 cm x 45 cm (11.8 in x 17.7 in.) rack

Power

- -48v feeds, 180 W maximum draw

Cooling

- One tray of eight fans

Operating environment

- Normal operating temperature range: -5°C to +45°C (23°F to 113°F)
- Short term (96 hours) extended temperature range: -5°C to +55°C (23°F to 131°F)
- Normal humidity: 5% to 85%
- Short term (96 hours) extended humidity range: 5% to 95%

Standards and protocols

Standards compliance

- IEEE 802.1p/Q VLAN Tagging
- IEEE 802.3 10BaseT
- IEEE 802.3u 100BaseTX
- IEEE 802.3x Flow Control
- IEEE 802.3z 1000BaseSX/LX

Protocol support

LDP

- RFC 5036 LDP Specification

MPLS

- RFC 3031 Multiprotocol Label Switching Architecture
- RFC 3032 MPLS Label Stack Encoding
- RFC 4379 Detecting Multi-Protocol Label Switched (MPLS) Data Plane Failures

Differentiated services

- RFC 2474 Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers
- RFC 2597 Assured Forwarding PHB Group
- RFC 2598 An Expedited Forwarding PHB
- RFC 3140 Per Hop Behavior Identification Codes

TCP/IP

- RFC 768 User Datagram Protocol
- RFC 1350 The TFTP Protocol (Revision 2)
- RFC 791 Internet Protocol
- RFC 792 Internet Control Message Protocol
- RFC 793 Transmission Control Protocol
- RFC 826 Ethernet Address Resolution Protocol
- RFC 854 Telnet Protocol Specification
- RFC 1812 Requirements for IPv4 Routers

PPP

- RFC 1332 PPP Internet Protocol Control Protocol (IPCP)
- RFC 1661 The Point-to-Point Protocol (PPP)
- RFC 1989 PPP Link Quality Monitoring
- RFC 1990 The PPP Multilink Protocol (MP)

ATM

- RFC 2514 Definitions of Textual Conventions and OBJECT-IDENTITIES for ATM Management, February 1999
- RFC 2515 Definition of Managed Objects for ATM Management, February 1999
- af-tm-0121.000 Traffic Management Specification Version 4.1, March 1999

- ITU-T Recommendation I.610 – B-ISDN Operation and Maintenance Principles and Functions version 11/95
- ITU-T Recommendation I.432.1 – B-ISDN user-network interface – Physical layer specification: General characteristics
- GR-1248-CORE – Generic Requirements for Operations of ATM Network Elements (NEs) Issue 3 June 1996
- GR-1113-CORE – Asynchronous Transfer Mode (ATM) Adaptation Layer (AAL) Protocols Generic Requirements, Issue 1, July 1994

Pseudowires

- RFC 4447 Pseudowire Setup and Maintenance using the Label Distribution Protocol (LDP)
- RFC 4385 Pseudowire Emulation Edge-to-Edge (PWE3) Control Word for Use over an MPLS PSN
- RFC 4717 Encapsulation Methods for Transport of Asynchronous Transfer Mode (ATM) over MPLS Networks
- RFC 4448 Encapsulation Methods for Transport of Ethernet over MPLS Networks
- RFC 5086 Structure-Aware Time Division Multiplexed (TDM) Circuit Emulation Service over Packet Switched Network (CESoPSN)
- RFC 5085 Pseudowire Virtual Circuit Connectivity Verification (VCCV): A Control Channel for Pseudowires

RADIUS

- RFC 2865 Remote Authentication Dial In User Service (RADIUS)
- RFC 2866 RADIUS Accounting

SSH

- draft-ietf-secsh-architecture.txt SSH Protocol Architecture
- draft-ietf-secsh-userauth.txt SSH Authentication Protocol
- draft-ietf-secsh-transport.txt SSH Transport Layer Protocol
- draft-ietf-secsh-connection.txt SSH Connection Protocol
- draft-ietf-secsh- newmodes.txt SSH Transport Layer Encryption Modes

TACACS+

- IETF draft-grant-tacacs-02.txt

Network Management

- ITU-T X.721: Information technology-OSI-Structure of Management Information
- ITU-T X.734: Information technology-OSI-Systems Management: Event Report Management Function
- M.3100/3120 Equipment and Connection Models
- TMF 509/613Network Connectivity Model
- RFC 1157 SNMPv1
- RFC 1907 SNMPv2-MIB
- RFC 2011 IP-MIB
- RFC 2012 TCP-MIB
- RFC 2013 UDP-MIB
- RFC 2138 RADIUS
- RFC 2571 SNMP-Framework-MIB
- RFC 2572 SNMP-MPD-MIB
- RFC 2573 SNMP-Applications
- RFC 2574 SNMP-User-Based-SM-MIB
- RFC 2575 SNMP-View-Based-ACM-MIB
- RFC 2576 SNMP-COMMUNITY-MIB
- RFC 2665 Ethernet-Like-MIB
- RFC 2819 RMON-MIB
- RFC 2863 The Interfaces Group-MIB
- RFC 2864 Inverted-Stack-MIB
- RFC 3014 Notification-Log-MIB
- RFC 3273 HCRMON-MIB
- RFC 3411 An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks
- RFC 3412 Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)
- RFC 3413 Simple Network Management Protocol (SNMP) Applications
- RFC 3414 User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)
- RFC 3418 SNMP MIB
- draft-ietf-disman-alarm-mib-04.txt
- draft-ietf-mpls-ldp-mib-07.txt
- IANA-ifType-MIB

Support for an extensive range of proprietary MIBs